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THE SOIL EROSION PROBLEM IN THE NORTH ATLANTIC STATES.

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Erosion is a natural process, without which the earth would not be habitable for mankind. The weathering of rocks, the formation of soil, the transportation of soil by wind, water, and ice have contributed a necessary encouragement to all forms of life on land and even in the air and in the oceans. Nature has also supplied agencies which restrain the eroding forces. A very important natural agency for the protection of soil from erosion is thick growing undisturbed vegetation, such as forests with unburned forest cover and thick meadow growth or pastures not overgrazed. When this protective cover is disturbed, however, by the cutting of forests, the overgrazing of ranges, the cultivation of the soil or the normal extension of the tributary gullies of a watershed, a new control of erosion must follow to prevent wastage. Let us consider this erosion problem in the northeastern States, including New England, New York, Pennsylvania, New Jersey, Maryland, Delaware, Virginia and West Virginia, the area from which the membership of this North Atlantic Section of the American Society of Agricultural Engineers is drawn.

This region of the country is less affected by the problem of erosion at present than areas south and west of it for a number of reasons. One of the most important of these reasons is probably the removal of large areas of marginal lands from cultivation by the westward migration of farmers, and the subsequent reforestation and conservation measures practiced over large areas. The trends in type of farming have also been favorable to erosion control, for not only have marginal farm lands become again protected by the vegetative cover of forests and grasses, but orcharding and the expanding dairy and poultry industries in these areas have promoted farm management practices and the use of pastures, crops and rotations conducive to erosion prevention. Other factors are the geology and climate of the area, more specifically soil and topography, rainfall and temperature.

The accompanying map of the Distribution of Erosion in the United States indicates the continuation of some of the most erosive soil areas of the Appalachian upland from the southern States northward through Virginia and West Virginia, Maryland, central New Jersey, much of Pennsylvania and a small area in southwestern New York. Isolated areas are indicated in the Hudson and Connecticut River Valleys and northeastern Maine.

The areas of this northeastern region not affected seriously by erosion are indicated as equally extensive, covering the coastal plains of Virginia, Maryland, Delaware, most of New Jersey, north-

western and northeastern Pennsylvania, and nearly the entire area of New York and the six New England States. The map of Regional Soil Erosion Areas suggests the influence of topography as well as soil types upon the rate of erosion.

The climatic factors are favorable to erosion prevention in New York and New England. The cool humid climate is conducive to the growth of erosion resistant vegetative coverage. The relatively long winter freezes afford protection through many days of the year without the disturbing effect of intermittent thaws, and the rainfall intensity is relatively less than in the more actively eroding areas farther south. The accompanying map of the Boundaries of Areas of Similar Rainfall Intensities for Short Periods indicates a decreasing ratio of intensity ranging from group 1 on the Gulf coast to groups 2, 3, 4, and 5 crossing these States. The ranges of acreage and frequency are recorded in the accompanying table. A comparison of the rainfall intensity map with the erosion maps will indicate the influence of this factor in its relation to topography and run-off upon erosion.

The relation of the seasonal intensity of rainfall to erosion upon land being cultivated is interesting. In a three year summary report of Soil Erosion and Run-off Experiments at Raleigh, North Carolina, ending May 31, 1927, F. O. Bartel, a drainage engineer of the Bureau of Agricultural Engineering states, "Erosion losses are greatest during the summer months when heavy and intense precipitation falls on a soil loose from cultivation. Three-fourths of the erosion occurred during the three summer months and nearly one-half of the run-off as compared with a third of the rainfall." He further emphasizes the relative effects of rainfall and cultivation by stating, "During June, July, August and September there occurred 45% of the annual rainfall, 64% of the run-off and 86% of the annual erosion." In this connection he notes that although 18-1/2% of the annual run-off occurred in September, it caused only 11% of the annual erosion upon cultivated soil. Since cultivation had ceased in August, he concludes, "Where land is under cultivation during the summer, it seems evident that protection by terraces is the only possible method of preventing a heavy loss of soil during this season," and states further "Any system of cover crops will be only partially effective in stopping erosion unless carried through the summer." These conclusions from experiments in a more southern location are cited merely to indicate the relation of intensity of rainfall during the cultivation season to the annual erosion losses.

Summarizing the situation for this area it is apparent the erosion problem is most important upon the cultivated fields of the rolling or hilly lands in Pennsylvania and New Jersey and the States southward. Upon all such land not adequately protected, erosion control practices should be inaugurated without delay. The general trend to reduce cultivated acreage should be encouraged, but is not likely to effect any rapid change in this area. Rotations of crops including legumes, small grains and cover crops are common. The rotation of

pastures and the use of manure is widespread in keeping with the extensive dairy, livestock, and poultry industries in this area. Nevertheless many badly eroded farms and fields are to be seen especially in the Piedmont Plateau area.

On eroding cultivated fields upon the Piedmont Plateau terracing is recommended to assure the physical protection of the soil from the eroding effect of rainfall run-off throughout all the variable degrees of erosion protection afforded by seasonal crop growth, cultivation and crop rotations. The residual protection afforded by the accumulation of organic matter is not overlooked in this connection. The protection which terraces afford from erosion will aid in the conservation of the humus and plant food restored to worn soils by proper crop rotations.

Erosion on farm lands is commonly described as sheet erosion and gully erosion. Of the two forms sheet erosion, though less spectacular, is the more disastrous to private and public agricultural resources. Sheet erosion is the removal of the surface layer of the topsoil without gullying. It frequently becomes most apparent and destructive upon freshly plowed fields subjected to torrential rainfall, where the loosened soil is washed away down to the plow-sole in the natural drainage depressions. Other common evidences of sheet erosion are the rivulets which form between the rows of cultivated crops. These evidences of sheet erosion are so frequently removed by tillage practices that farmers are not aware of the losses of 10 or more tons of soil per acre annually which occur on unprotected cultivated slopes of from 2% to 12%. Six inches of top soil have been washed off the cultivated fields of many farms in a generation of farm life. Attempts to fertilize and to restore fertility on fields affected by sheet erosion are only partially effective and are wasteful unless erosion protection practices accompany them.

For eroding fields with slopes of from 2% to 12%, which must be used to produce row crops in rotation with other crops, the protection recommended is terracing with the rows planted parallel to the terraces, and the use of soil improving crops in the rotation. These simple recommendations have been followed to the extent that 600,000 farmers have protected 18,000,000 acres of land with terraces and soil saving dams in the 19 years during which Cooperative Extension Work has been in operation. These figures are from the county agents annual statistical records and relate almost exclusively to terracing, but in practice the terraced fields are almost invariably planted with the rows running parallel to the terraces, thus acting as miniature terraces partially effective in retarding run-off. Soil improving cropping practices also usually accompany terracing as would be expected where farmers have become aware of their erosion losses.

Since terraces were recommended by agricultural scientists before the inception of extension work, it will doubtless be of passing interest to this group of engineers to note that studies of hillside drainage to control erosion on farm lands by means of terraces

and tile drainage were first begun by the Division of Drainage Investigations, Office of Experiment Stations, U. S. Department of Agriculture, in the year 1903. Following these studies demonstrations of the Mangum type of terrace were made extensively in the Cotton Belt by engineers. Agricultural workers from the State Colleges and Experiment Stations also promoted erosion control by means of terraces and cropping practices. In 1914 more extensive engineering field studies of terraces were made, which were soon followed by run-off studies on small agricultural areas. Erosion is primarily a hillside drainage control problem, hence it is not surprising that for 18 years the U. S. Department of Agriculture bulletins on Terracing, prepared by engineers, have been the most popular texts on erosion control practices upon agricultural lands. However, in the extension work the recommendations for terracing are properly correlated with the cropping practices, which are essential for the best soil conservation as well as for soil improvement.

In Cooperative Extension Work, the respective State Extension Services take the initiative in making local recommendations in any endeavor to improve farm conditions. All but three of the States in this northeastern group have reported some engineering types of soil saving work supervised by county agricultural agents, during the past 10 years. Of the three States not reporting, all are on the coast and only one has even a small erosion problem. Virginia, the southernmost State represented here, as might be expected, has accomplished the most terracing, having terraced 40,000 acres in the past 10 years. The 1932 report from Virginia was 6419 acres terraced upon 843 farms.

A program of erosion control and soil improvement has been promoted continually by the Extension Service since 1914. As early as 1919 a one-year Extension Service record of 1,243,696 acres terraced upon 30,088 farms was made in the Cotton Belt. The highest record is for the year 1931 when 1,870,174 acres were reported by county agents as protected by terraces and soil saving dams installed upon 48,717 farms. These figures indicate the steady stimulation the Extension Service has exerted upon the public attitude toward erosion losses. The cumulative effect of this work has directed public interest to the national erosion problem.

In January 1929 investigations were begun by the U. S. Department of Agriculture to obtain experimental data relating to erosion in order to improve methods and reduce the cost of Erosion Control. Ten soil erosion experimental farms have since been established on which correlated studies are being conducted by the Bureau of Agricultural Engineering, the Bureau of Chemistry and Soils, and State Agricultural Experiment Stations. The farms are located in regions representing wide differences of soil, climate, topography and farming practices. The experimental erosion farms at Statesville, North Carolina and Zanesville, Ohio, are closest to this area. Conclusions from these experiments will doubtless be useful in States represented here.

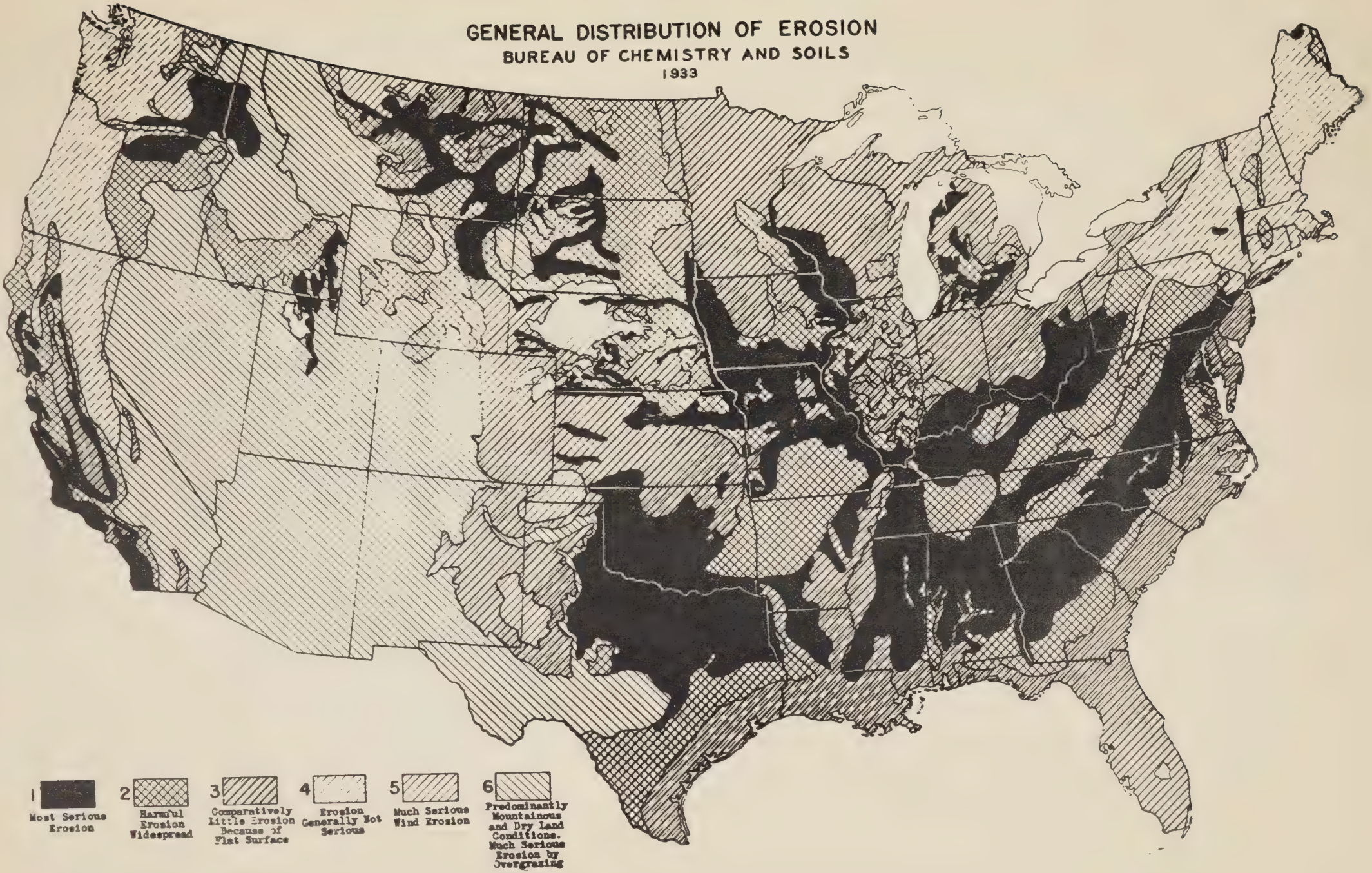
Two recent developments in the national treatment of the problem are also of interest. The first of these is the Erosion Control Work of the Civilian Conservation Corps. The U. S. Forest Service has charge of the field activities of this corps, but it has called upon the Bureau of Agricultural Engineering for advisory aid and assistance in the supervision of the engineering gully control work. The second national development is the formation of a new Erosion Control Service in the Department of the Interior to control erosion upon watersheds of from 100,000 to 200,000 acres as demonstration areas in many States. The results obtained upon the erosion experimental farms, previously mentioned, will be applied in the protection of all eroding land within these watersheds, whether under cultivation or not. The use of suitable vegetative cover, cropping practices, and drainage control structures and devices to effect erosion control are to be demonstrated under regional agreement and management for each selected watershed.

The Extension Service in its 20th year of experience in erosion control extension work, and associated with still longer experience in allied researches in the U. S. Department of Agriculture, continues to offer its recommendations to the farmers for the protection of farm land from erosion, emphasizing the most serious problem, the erosion of cultivated fields.

GENERAL DISTRIBUTION OF EROSION

BUREAU OF CHEMISTRY AND SOILS

1933



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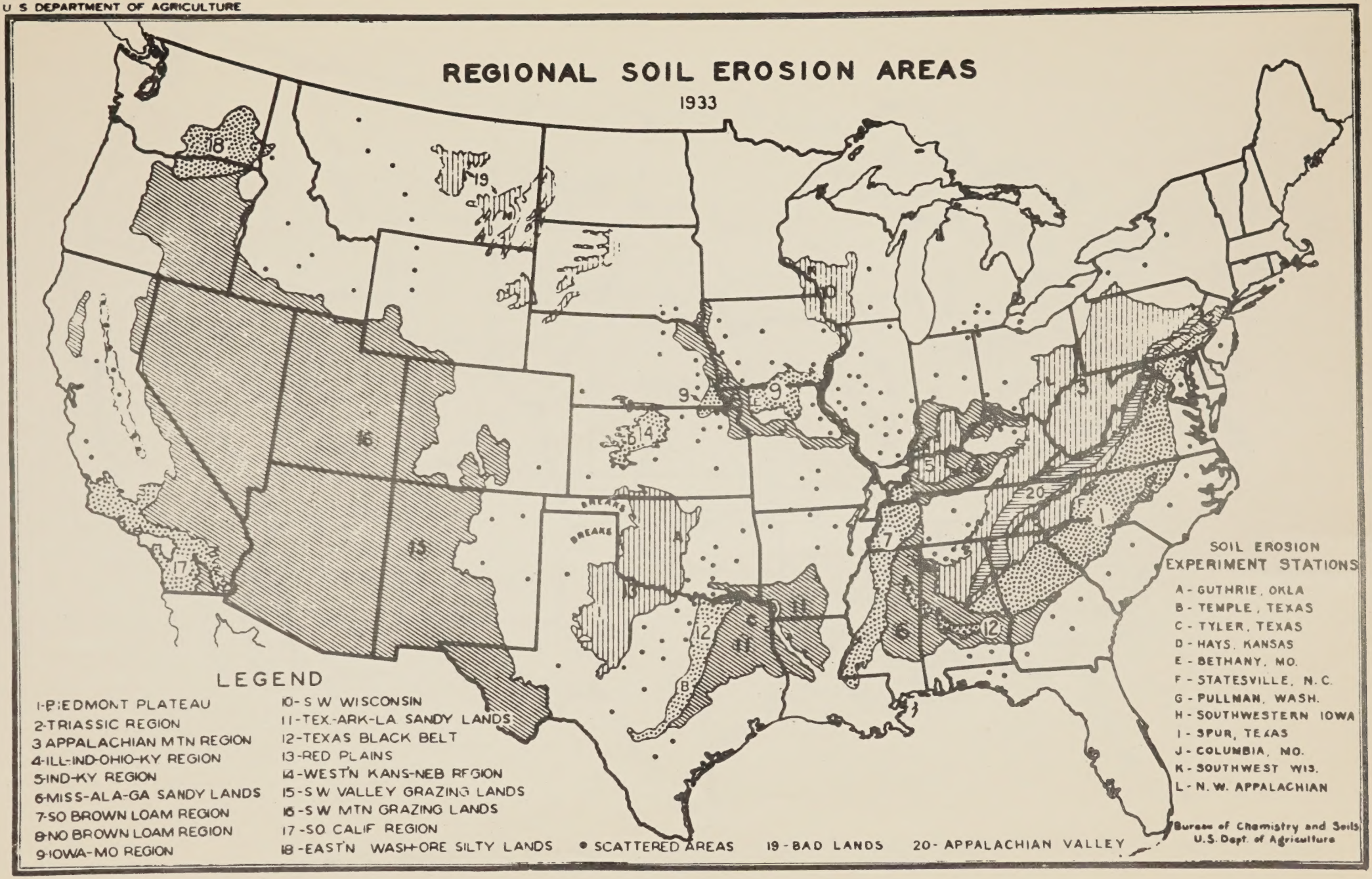

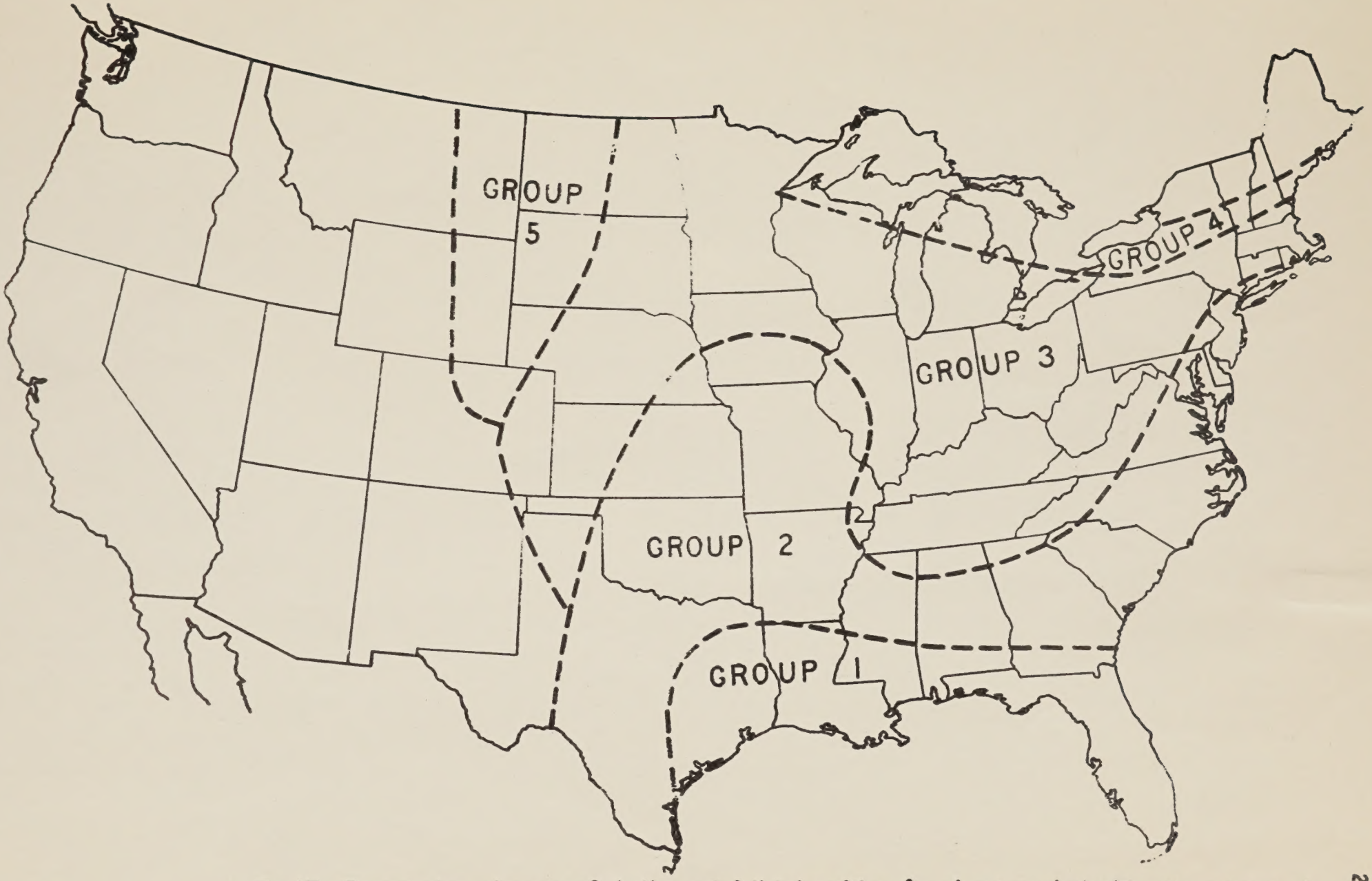

Fig. 17.– Boundaries of areas of similar rainfall intensities for short periods. *(From Meyers Hydrology)*